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ABSTRACT

This booklet was created to assist teachers in integrating local environmental education topics into their classroom curriculum. It comprises curricular and instructional materials for developing students' awareness about and concern for water resources, and taking action to protect them. It enables students to learn that they are able to make a difference by helping to solve community water-related problems and that work on controversial water-related issues can achieve positive results for the community. This project fosters learning the skills of inquiry in conjunction with learning to use technology to aid in the inquiry process. The curricular materials included can be utilized in social studies, science, mathematics, and language arts classes. Each curricular topic includes the general goal, specific student objectives, procedure for instruction, assessment strategies, and the resources to implement each topic. Topics include: stormwater runoff, erosion and sedimentation, household pollutants, environmental action, nutrient enrichment, water quality monitoring, limnological testing, water treatment plants, waste water treatment plants, studying a stream from headwater to mouth, groundwater, wetlands, acidity/acid precipitation, and computer technology. A list of audio visual materials and valuable contacts is also included. (JRH)

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STREAMS

Science Teams in Rural Environments for Aquatic Management Studies

An Interdisciplinary Environmental Education and Water Study Program Incorporating National Science and Math Standards, Authentic Assessment, Fields Studies, Technology and Student/Community Activism

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This publication was prepared by Frederic R. Wilson, with assistance from Timothy E. Julian, in cooperation with the Juniata College Science in Motion Outreach Program, Research For Better Schools, Inc., The Center for Rural Pennsylvania, the Pennsylvania Space Grant Consortium, and the Pennsylvania State Education Association. It is intended to help teachers integrate environmental education into their school curriculum.

Additional copies of this book can be obtained from the following address:

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The title and acronym STREAMS was created by Richard F. Devon Ph.D, Director, Pennsylvania Space Grant Consortium.

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STREAMS

Science Teams in Rural Environments for Aquatic Management Studies

An Interdisciplinary Environmental Education and Water Study Program

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Special acknowledgment needs to be given to the Pennsylvania Bay Education Office, Harrisburg, PA for mini-grants to enable students to have the hands-on, field study experiences, to the people affiliated with the summer teacher training workshops from the Chesapeake Bay Foundation and the Juniata College Science in Motion program, and to the energetic Huntingdon Area Middle School students who have immersed themselves in their environmental studies.

Frederic R. Wilson
Project Director

How to Use This Resource

This booklet was created to assist teachers in integrating local environmental educational topics into their classroom curriculum.

First, examine the table of contents for a summary of the Interdisciplinary Environmental Education and Water Program. Next, read the Overview and the Program Narrative on pages 1-5, and review the list of topics found on page 6.

The curriculum information and applications for implementing the topics are described in the Curricular Topics on pages 7-46. Here the reader will find the general goal, the specific student objectives, the procedure for instruction, assessment strategies, and the resources to implement each topic. The Resources To Implement section provides the crucial content necessary to teach each topic for the teacher.

Pages 50-51 provide a listing of valuable contacts and audio visual materials that will save you hours searching for materials and enable you to get a good start in developing your own program.

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Overview

Interdisciplinary Environmental Education and Water Study Program (as described on the RBS Gopher)

Interdisciplinary Environmental Program for Middle Schoolers Develops Awareness of and Concern About Water Resources

SUBJECTS: Acid Rain; Air Pollution; Environment; Environmental Education; Groundwater; Mathematical Applications; Outdoor Education; Outdoor Activities; Pollution; Recycling; Scientific Methodology; Social Studies; Statistics; Technology; Water; Wetlands

GRADE LEVEL: Grades 5-8

TARGET AUDIENCE: Rural Students

INSTRUCTIONAL METHODS: Activities; Brainstorming; Cooperative Learning; Discovery Learning; Experiments; Field Trips; Hands on Learning; Independent Study; Individualized Instruction; Interdisciplinary Approach; Problem-Solving Approach; Small Groups; Visual Learning;

The Interdisciplinary Environmental Education and Water Study Program for middle grades focuses attention on the resource of water. The program comprises curricular and instructional materials for developing students' awareness about and concern for water resources, and for taking action to protect them. Students learn that they are able to make a difference by helping to solve community water-related problems, and that work on controversial water-related issues can achieve positive results for the community. Many environmental topics are integrated into hands-on learning activities. The curricular materials can be utilized in social studies, science, mathematics, and language arts classes. An interdisciplinary team of teachers would best be able to maximize the potential of the program, although individual teachers also will find it useful. Environmental topics of study include acid rain, air pollution, groundwater, recycling, and water quality. Skills of inquiry (i.e., framing researc problems, collecting data, analyzing data, interpreting data, formulating alternative solutions to problems) are learned in conjunction with learning to use technology to aid in the inquiry process. Among the many kinds of activities students actively engage in are brainstorming, discovery learning, experiments, field trips, individualized instruction, and small group work. Upon completing the program, students will understand the interacting influences of a watershed, factors that have a negative impact on a watershed, and how to devise various solutions for resolving problems.

MATERIALS: Curriculum Frameworks; Group Projects; Individual Projects; Individualized Materials; Individualized Programs; Integrated Materials; Lesson Plans; Program Descriptions; Supplementary Materials; Teacher Developed Materials; Teaching Units; Units of Study

MEDIA: Calculators; Charts; Computer Software; Databases; Slides; Videotapes

LANGUAGE: English

ASSESSMENT: Achievement Tests; Field Tests; Performance Assessment; Teacher-Made Tests; Exceptional student evaluation of program (e.g., positive attitudes towards: outdoor education, field work, hands-on activities and and making decisions); Curriculum evaluations from outside sources; Community commendations and recognition of students local environmental stewardship projects; Student presentations at civic organizations and educational conferences; Number of students participating in and completing voluntary environmental projects; Increase in overall student grade average; Newspapers and newsletters coverage of program by organizations throughout state and nation; Number of inquiries by educators; Excellent evaluations at conference presentations; Anecdotal comments and written letters from parents; Student attitude surveys; Teacher evaluations

INTENDED OUTCOMES: Analyzing; Collecting and Recording Data; Communicating; Critical Thinking; Decision Making; Environmental Awareness; Interpreting Data; Problem Solving; Reasoning; Science Process Skills

FUNDING DATE: 1991

EVALUATION: Program effectiveness is measured by degree of student involvement; student competency in performing certain tasks such as collecting, analyzing, and interpreting data; success of individual projects; and student community action projects.

RECOGNITION: 1994, Selected as a Promising Practice, Mid-Atlantic Regional Consortium for Mathematics and Science Education, Research for Better Schools; 1993, Huntingdon County Environmental Achievement Award; 1992, Pennsylvania Department of Education, one of five exemplary programs for the Environmental Search for Excellence.

IMPLEMENTATION: Replication of this program requires access to a local stream and outdoor environment. Inservice for teachers on conducting water monitoring tests, and workshop on environmental issues is suggested before adoption.

EQUIPMENT: Water monitoring equipment, slide projector, overhead projector, VCR, computers, spreadsheet software.

COST: $25-50 per water monitoring kit (dissolved oxygen, water hardness, alkalinity, nitrate, phosphate), electric ph meter, seine net, 50m metric meter tape, water quality water manual, collection trays; transportation to field studies sites will vary; groundwater model.

AVAILABILITY: Teacher training can be obtained at Pennsylvania Intermediate Unit summer workshops, Chesapeake Bay Teacher Training Courses (center located in Annapolis, MD), and from science teacher colleagues.

SUPPORT: Support can be obtained from an interdisciplinary team of teachers, conservation agency personnel, water and waste treatment agency personnel, high school students, Juniata College Outreach Program (Bio and Chem Vans), and Pennsylvania Space Grant Consortium.

FUNDING: Pennsylvania Bay Education Office, Center for Rural Pennsylvania, local business and industry, private contributions.

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Program Narrative

The Interdisciplinary Environmental Education and Water Study Program (STREAMS) is taught at the Huntingdon Area Middle School. Its aim is to help middle school students become more aware and concerned about their environment's water resources and, thus, to empower them to take action to protect those resources. Students study and participate in small group work to conduct, evaluate, collate and report their environmental discoveries.

To engage in the curricular topics, the students participate in a variety of activities. Word processing and database computer skills will be necessary for some of these studies. Opportunity will also exist for students to work across grade levels in a computer networking program. Last year, students used over 40 hours of school time for project work.

Local watersheds are examined to make the learning more relevant and meaningful for the students. Field studies occur to the Muddy Run Watershed, Standing Stone Creek, Juniata River, and Huntingdon's Waste Treatment and Water Treatments facilities. Students learn types of pollution, water monitoring techniques, how to use testing equipment, and what to look for prior to the field studies.

The Muddy Run Watershed has environmental conditions and problems which can easily be related to other larger watersheds. Although a very small watershed, 2.4 square miles, many residential homes are within its borders. Its proximity to the school creates ideal outdoor educational opportunities. Students tour different housing developments documenting positive and negative land management practices related to stormwater runoff, erosion and sedimentation problems, and pollutants observed. Extensive water monitoring tests are conducted to ascertain its water quality.

Stone Creek, a residential and agricultural watershed with no industries, is examined from its waterhead to mouth to learn the characteristics of a drainage basin. Students survey the streams depth, width, speed, volume, and temperature at four locations and evaluate the water quality, with particular attention given to nutrient enrichment, e.g., nitrate and phosphate.

At the Juniata River, limnological tests for water temperature, depth, speed, volume, turbidity and plankton life are also conducted.

The processes for cleaning drinking water before domestic use and waste water before its re-entry into a river are learned by touring the local water and waste treatment facilities.

The negative impact of coal mining are studied at the previous Joller Mine site in the Broad Top area, specifically the problems of acidity on a watershed.

By visiting the created wetlands at Raystown Lake, students have the opportunity to observe and examine first hand the vital need of these beneficial land areas.

Upon completion of this study, the students realize the interacting influences of a watershed, are able to recognize problems or events which have a negative impact on a watershed, and are able to generate various solutions to resolving these problems. The conditions and problems confronting these local watersheds are interrelated to those of the Chesapeake Bay and total environment.

The interdisciplinary study involves the five classes of science, social studies, math, language arts and reading. There is extensive collaboration involving science and social studies. All team teachers assist in the outdoor field studies and activities. Every student participates in the main core of the program, forty hours, at the beginning of each school year. Thereafter, any student can participate in voluntary environmental projects and activities throughout the school year.

This program could be integrated into any school district. Environmental topics and activities could be applied at different grade levels with relative ease. However, an interdisciplinary or team approach allows for greater flexibility in presenting the materials and for finishing more student activities. In schools where self-contained classrooms exist, a reduction in the scope of study might be necessary because of the time factor.

The strength of the unit involves the contribution and participation of all the team teachers (science, social studies, math, language arts and reading) and the students.

Instrumental to the success of this educational endeavor has been the cooperation of people in this community, outside resources, and the team teaching approach which exist at the Huntingdon Area Middle School. However, the key factor has been the students. They have been extremely receptive to learning about the environment and have done an outstanding job with their field studies and action projects. Their excitement and enthusiasm is effecting the environmental attitude of the adult population of this community.

Curricular Topics

1: Environmental Introduction
2: Stormwater Runoff
3: Erosion & Sedimentation
4: Household Pollutants
5: Environmental Action: Letter Writing
6: Nutrient Enrichment
7: Water Quality Monitoring of Muddy Run
8: Water Quality Monitoring of Standard Stone Creek/Juniata River
9: Limnological Testing of Juniata River
#10: Water Treatment Plant
#11: Waste Water Treatment Plant
#12: Studying a Stream From Headwater to Mouth
#13: Groundwater
#14: Wetlands
#15: Acidity/Acid Precipitation
#16: County Water Quality Monitoring Program
#17: Computer Technology

1: Environmental Introduction

Goal:

The students will learn basic environmental water-related concepts to provide a foundation for participation in the Environmental Education and Water Study Program at the Huntingdon Area Middle School.

Objectives:

1. The students will define environment.
2. The students will list the parts of the water cycle (precipitation, runoff, groundwater, transpiration, evaporation, and condensation).
3. Given a chart, the students will label the parts of the water (hydrologic) cycle.
4. The students will explain why the earth is called a water planet.
5. The students will define the term "watershed".
6. Given a watershed model, the students will identify the boundaries of a watershed.
7. The students will use a watershed model to trace the flow of water in the watershed.
8. The students will define the term "pollution".
9. The students will list different types of pollution.
10. The students will categorize different types of water pollution and list examples of each.
11. The students will define the terms "point" and "nonpoint source" pollution and give examples of each.
12. The students will verbally explain how humans influence the water environment.
13. The students will define the terms:
    a. stormwater water runoff
    b. erosion
    c. nutrient enrichment
    d. groundwater
    e. acid rain.

Assessment:

Teacher-Made test of student selected vocabulary.

Procedures:

All students take a pre-test to ascertain what they currently know about the topics of study in the program. The same test is given three months after their study. Students receive a booklet prepared by the teacher and a packet of environmental charts and graphs. Each section of the handout is read by the students and discussed. Visualization of the concepts is provided by the charts and graphs. The teacher also has an assortment of other transparencies to use in the presentation. Students brainstorm and categorize environmental information throughout the introduction. Each student receives a packet of vocabulary terms that they must define as they go through the program.

Resources to Implement:

Teacher handouts:	Introduction to Environmental Education (selected adaptations from Aquatic Project Wild) Vocabulary Packet
Videos:	Water A Precious Resource
Transparencies:	The Water Cycle (KARE Water Resources in PA) Sources of Water Pollution (Water Quality and Pollution, Milken Company) Distribution of Earth's Water (KARE Water Resources in PA) Distribution of Earth's Water (KARE Water Resources in PA) Rainfall in Pennsylvania (KARE Water Resources in PA) Drainage Basins in Pennsylvania (KARE Water Resources in PA How Acid Rain Forms (KARE Water Resources in PA) Groundwater Pollution (KARE Water Resources in PA) Garbage Generated in USA (Water Wise Lessons in Water Resources) Average Family Use Chart (Water Wise Lessons in Water Resources) pH range that supports aquatic life (Water Wise Lessons in Water Resources) Biodegradable waste and the water environment (KARE Water Resources in PA) Muddy Run Watershed (Huntingdon Conservation Agency)
Literature:	Aquatic Project Wild (obtained at Intermediate Unit)

Equipment:	VCR/TV Overhead Projector/Screen Muddy Run Watershed Model
Maps:	Muddy Run Watershed Huntingdon County Pennsylvania Chesapeake Bay Watershed

2: Stormwater Runoff

Goal:

The students will be involved in a action project where they gain an understanding of the attributes of positive and negative stormwater management practices in the Muddy Run Watershed area, thereby being able to make an impact on their local waterways as well as the Chesapeake Bay watershed.

Objectives:

1. The students will define "stormwater management."
2. The students will list three practices that help eliminate water runoff and flooding.
3. The students will explain the impact of excessive water runoff on a watershed.
4. The students will recognize positive or negative attributes of a housing development on site.
5. The students will recall the three major pollutants of stormwater runoff and give examples of each
   a. toxic materials
   b. sedimentation
   c. nutrients.
6. The students will produce a list of positive stormwater practices that can reduce the level of stormwater runoff in the residential areas of the watershed.

Procedures:

After studying stormwater runoff in the classroom, students participate in a fieldtrip to developments located in the Muddy Run Watershed: 1) Hollywood, 2) Stewart Development, 3) Taylor Highlands, and 4) Stone Creek Watershed (Onieda Development). The students observe, document, and/or take pictures of positive stormwater management practices and common negative practices that have affected the watersheds. This information is used in different culminating activities of the unit.

Assessment:

Alternative Assessments, e.g., students 1) participate in and complete a cooperative learning activity to chart the water cycle, 2) cooperatively list and explain ten land management practices that prevent stormwater runnoff in the Muddy Run Watereshed, 3) participate in a stormwater management project, 4) identify ten negative land management practices in the Muddy Run Watershed; Teacher-Made Test

Resources to Implement:

Teacher handouts:	Pollution: General Fact Sheet Solutions to the Problem Activity Stormwater Runoff & Erosion Data Sheet (for field study) Positive and Negative Land Management Practices of Muddy Run Watershed (based on student findings of field studies) Introduction to Environmental Education (selected adaptations from Aquatic Project Wild) What Are The Bay's Problems today?
Slides:	Muddy Run Watershed- Location Shots (teacher created) Muddy Run Watershed- Stormwater Runoff (teacher/student created) Muddy Run Watershed- Negative Land Management Practices (teacher/student created) Muddy Run Watershed- Positive Land Management Practices (teacher/student created)
Videos:	Pointless Pollution (CBF) Into the Water, Into the Bay (CBF)
Transparencies:	The Water Cycle (KARE Water Resources in PA) Sources of Water Pollution (Water Quality and Pollution, Milken Company) Distribution of Earth's Water (KARE Water Resources in PA)
Literature:	Distribution of Earth's Water (KARE Water Resources in PA) The Water Cycle " Rainfall in Pennsylvania " Drainage Basins in Pennsylvania " Aquatic Project Wild
Equipment:	Slide Projector/Screen VCR/TV Overhead Projector/Screen Camera (optional)
Field Study:	Muddy Run Watershed (Hollywood & Shadyside developments)

3: Erosion and Sedimentation

Goal:

The students will engage in a neighborhood action project where they learn the effects erosion and sedimentation buildup have on a watershed, e.g., Muddy Run, Juniata River, Stone Creek, Susquehanna River, and Chesapeake Bay.

Objectives:

1. The students will define "erosion" and "sedimentation".
2. The students will state why sedimentation and erosion are harmful to a watershed in terms of:
   a. turbidity
   b. photosynthesis
   c. toxic materials
   d. nutrient enrichment (nitrate, phosphate, animal waste).
3. Participating in a walking fieldtrip, the students will identify erosion or sedimentation trouble spots in their environment, e.g., school, lawns, streams, neighborhoods.
4. The students will write a plan for reducing general erosion problems in the watershed.

Procedures:

Students participate in a field study walk through the development section of Huntingdon where Muddy Run is located after studying erosion and sedimentation in the regular class. The students observe, document, and/or take pictures of obvious problem spots of erosion and sedimentation buildup and collect data for having tests conducted. Students work cooperatively in small heterogeneous groups to prepare a list of problems and possible solutions that is used in various culiminating activities.

Assessment:

Alternative Assessments, e.g., students 1) complete cooperative exercise dealing with erosion/sediment, 2) locate a minimum of five

erosion or sedimentation problems during field study walk of Muddy Run Watershed housing developments, 3) create a list of positive land management practices which can prevent or slow erosion down and explain how each practice prevents erosion or sedimentation from occurring; Teacher-Made Test

Resources to Implement:

Teacher handouts:	Pollution: General Fact Sheet Solutions to the Problem Activity Stormwater Runoff & Erosion Data Sheet (for field study)
Slides:	Muddy Run Watershed-Location Shots (teacher created) Muddy Run Watershed-Stormwater Runoff (teacher/student created) Muddy Run Watershed- Negative Land Management Practices (teacher/student created) Muddy Run watershed- Positive Land Management Practices (teacher/student created) Stone Creek- Location Shots (teacher created)
Videos:	Into The Water, Into The Bay (CBF) The Ripple Effect (CBF) The Water Cycle and Erosion (PA Fish and Boat Commission) slower students
Equipment:	Watershed Model (4' * 5') VCR/TV Slide Projector/Screen Camera (optional)
Field Study:	Muddy Run Watershed (Hollywood, Shadyside, Oneida) Standing Stone Creek Watershed (four stops)

4: Household Pollutants

Goal:

The students will become aware of pollutants that enter the Muddy Run Watershed from households as well as other point and nonpoint sources, thereby enabling students to understand how personal values and attitudes affect not only the degradation of their immediate environment but also other areas as well.

Objectives:

1. The students will list three common pollutants that come from homes.
2. The students will state one to three ways they could change their lifestyle to assist in reducing environmental degradation.
3. The students will recognize what is meant by point sources of pollution from these specific areas:
   a. sewage
   b. industrial or chemical dumping
   c. large construction sites
   d. mining
   e. power plants.
4. The students will list these nonpoint sources of pollution:
   a. agricultural runoff
   b. urban runoff
   c. small construction
   d. forestry
   e. acid rain.
5. The students will observe and document common household pollutants while participating in a fieldtrip walk.
6. The students will participate in small groups to write a list of common household pollutants.

Procedures:

All students record and document common household pollutants observed during a fieldtrip. Students do voluntary family lifestyle examinations (see Conservation Projects-LifeStyle Analysis

obtained from Chesapeake Bay Foundation) to ascertain the impact their families have on the local watersheds and the total Chesapeake Bay Watershed. Students work in small groups to discuss and review literature dealing with pollution sources. Then students prepare a group plan for reducing harmful substances that enter the watersheds from individual homes and/or a community.

Assessment:

Teacher-Made Test; Alternative Assessment, i.e., cooperative learning activity to give one alternative product to various household products which are not environmentally unsafe or pollute the environment; Home Lifestyle Analysis survey completed with parents

Resources to Implement:

Teacher handouts:	Solutions to the Problem Activity Pollution Data Sheet (for field study) Lifestyle Analysis Survey Common Household Product Alternatives (student created) Introduction to Environmental Education (selected adaptations from Aquatic Project Wild)
Slides:	Household Pollutants (created by students)
Videos:	Pointless Pollution (CBF) Hey! Hey! It's Happening Today on the Chesapeake Bay (CBF) The Ripple Effect (CBF) Into the Water, Into the Bay (CBF)
Transparencies:	Garbage Generated in USA (Water Wise Lessons in Water Resources, 1989) Sources of Pollution Sources of Water Pollution (Water Quality and Pollution, Milken Company)
Literature:	Pointless Nonpoint Pollution (KARE Living in Water p. 13) Average Family Water Use Chart (Water Wise Lessons in Water Resources, p. 6) Pollution Information Sheet (Aquatic Project Wild, p.141.) Household Hazardous Waste Products Wheel (Anne Arundel Count, MD)
Equipment:	Slide Projector/Screen VCR/TV Overhead Projector/Screen
Field Study:	Home Inventory And Analysis (Optional, student created)

5: Environmental Action: Writing a Standard Business Letter

Goal:

The students will actively participate as concerned citizens to preserve our natural water/land resources and to reduce environmental degradation.

Objectives:

1. The students will exhibit an understanding of the integration of language arts, social studies, and science by writing a one page report about sediment control, stormwater runoff or pollution learned in their Muddy Run unit.
2. The students will write a standard business letter applying the basic rules for such, as well as use proper capitalization and grammar rules learned in Language Arts.
3. The students will write a business letter based on any interest of their choice concerning what they have learned from the Muddy Run Watershed Unit to a proper authority or adult.
4. The students will participate in taking environmental action by writing a letter to an audience of their selection that expresses their individual concerns.

Procedures:

After completion of the Muddy Run Watershed Project, all students write letters to any appropriate authority about their concerns or interests. They can select authorities from the local, state, or national levels. The standard practices for preparing the letters are taught in the language arts and social studies classes.

Assessment:

Alternative Assessments, e.g., students 1) write a business letter to a political leader or authority of their choice using satisfactory language arts skills, 2) complete voluntary individual/small group environmental projects like environmental survey and analysis to gain primary information for letter writing, 3) give a speech to

class or organizations, 4) write a paper on environmental topic of interest to student, 5) create environmental posters, 6) write environmental picture captions, 7) write article for school paper

Resources to Implement:

Teacher handouts:	Letter Writing Outline for Standard Business Letter Samples of Standard Business Letter Addresses of political leaders at local, state and national levels
Transparencies:	Letter Writing Outline for Standard Business Letter
Literature:	Language Arts text
Equipment:	Overhead Projector/Screen
Posters:	Numerous enlarged letters on display

6: Nutrient Enrichment

Goal:

The students will become aware of pollutants that enter the watershed from agricultural sources thereby enabling students to understand that the misapplication of fertilizers can cause the degradation of their immediate environment and other areas as well.

Objectives:

1. The students will list three common forms of nutrient enrichment that come from farms:
   a. phosphate
   b. nitrate
   c. manure.
2. The students will state practices farmers could implement to reduce the amounts of nitrates and phosphates entering the watershed from their property, thus reducing environmental degradation.
3. The students will list these nonpoint sources of pollution:
   a. agricultural runoff
   b. urban runoff
   c. small construction
   d. forestry
   e. acid rain.
4. The students will state what is meant by point source of pollution; some examples follow:
   a. sewage
   b. industrial or chemical dumping
   c. large construction sites
   d. mining
   e. power plants.
5. The students will conduct water monitoring tests on Standing Stone Creek to determine its nitrate and phosphate levels.
6. Given the nitrate and phosphate levels in Standing Stone Creek, the students will assess if a nutrient loading problem exists in this watershed.
7. The students will define "best management practice" (BMP).

8. The students will forward the results of their study and water tests to the local Soil Conservation Agency's, Nutrient Enrichment Technician.
9. The students will explain what natural or man created factors can reduce the levels of nutrient loading entering the water, e.g., natural vegetation, wetlands, and BMP's.
10. The students will participate in small groups to create a plan for resolving a specific nutrient loading problem that exist, e.g., nitrate or manure entering the water.
11. The students will explain the effects nitrates and phosphates have on aquatic life and vegetation in a stream.
12. The students will define and give examples of "nutrient enrichment."
13. Given a stream insects and crustaceans sheet, students will:
    a. identify the macroinvertebrate groups found in the water
    b. identify the water quality of the stream.
14. Students will organize and keep records of collected data.

Procedures:

Students participate in a fieldtrip to agricultural areas within the Stone Creek Watershed after studying nutrient enrichment at school. Water samples are collected and sent away to ascertain the nitrate and phosphate levels. The students document any negative environmental practices or problems witnessed. Students interact in small groups to discuss and review literature dealing with agricultural pollution. A group plan for reducing the volume of harmful substances entering the watershed from agricultural sources is developed by the students. Then, the students' conclusions are shared in small and large group discussions.

Assessment:

Performance Assessments, e.g., students 1) analyze a stream for dissolved oxygen, 2) conduct water quality tests for phosphate, nitrogen, dissolved oxygen, dissolved solids' levels; Alternative Assessments, e.g., students 1) explain in writing how nutrient enrichment effects a stream, 2) create a plan to prevent nutrient loading of a stream; Teacher-Made Test; Take Home Exam

Resources to Implement:

Teacher handouts:	Pollution: General Fact Sheet
Slides:	Standing Stone Creek- Location Shots (teacher created) Muddy Run Watershed- Location Shots (teacher created) Muddy Run Watershed- Negative Land Management Practices (teacher/student created)
Videos:	Into the Water, Into the Bay (CBF) Pointless Pollution (CBF) Hey! Hey! It's Happening Today on the Chesapeake Bay (CBF)
Transparencies:	Biodegradable waste and the water environment (KARE Water Resources in PA)
Literature:	Pollution Information Sheet (Aquatic Project Wild, p. 141) Biodegradable waste and the water environment (KARE Water Resources in PA)
Equipment:	Slide Projector/Screen VCR/TV Overhead Projector/Screen
Field Study:	Standing Stone Creek Muddy Run Watershed
Posters:	Numerous

7: Water Quality Monitoring
Muddy Run

Goal:

The students will conduct water monitoring tests on a stream to determine its quality.

Objectives:

1. The students will collect water samples from the Muddy Run Watershed in order to conduct tests for common hazardous waste, chemicals, or ingredients:
   a. nitrogen
   b. phosphate
   c. dissolved oxygen
   d. pH levels
   e. coliform bacteria (may have to been done by teacher or sent away for professional evaluation).
2. The students will conduct a stream survey to examine its aquatic life (macroinvertebrates).
3. The students will observe and look for physical problems of a stream, i.e., sediment from erosion.
4. The students will explain what dissolved oxygen is and explain how it affects aquatic life.
5. The students will ascertain if the dissolved oxygen level in Muddy Run can support varieties of aquatic life.
6. The students will explain how coliform bacteria affects the oxygen level of water and aquatic life.
7. The students will interact in small groups.
8. The students will store collected data in a computer.

Procedures:

Water samples are obtained during field study walks to the Muddy Run Watershed and of the Standing Stone Creek for evaluation. The coliform bacteria testing is done by professionals. Teachers and personnel from the Juniata College Science Outreach Program, Science in Motion (Biovan) assist students in conducting tests for dissolved oxygen, pH, nitrates, phosphates, alkalinity, total

hardness, and/or aquatic life. The students also document any sediment or erosion observed. Collected bug specimens are identified with microscopes at the school. The information gathered is used in different culminating activities related to identifying and resolving environmental degradation concerns. Information is disseminated to other students for possible independent computer analysis projects.

Assessment:

Teacher-Made Test, Performance Assessments, e.g., students conduct water tests for pH, nitrogen, phosphate, dissolve solids, dissolved oxygen, macroinvertebrates, stream speed, stream volume, stream depth, and water temperature; Alternative Assessments, e.g., students 1) fill water quality data sheet for Juniata College and DER Bureau of State Parks, 2) do a stream analysis and record data.

Resources to Implement:

Teacher handouts:	Most Common Measured Water Quality Parameters Water Quality Data Sheet Water Hardness Instruction Sheet (for Lamotte kit) Dissolved Oxygen Instruction Sheet (for Hach kit) Macroinvertebrate Identication Sheets (used with permission of Juniata College)
Videos:	SOS Water Quality Monitoring (Izaak Walton League)
Literature:	SOS Stream Insect & Crustaceans (macroinvertebrate ID sheet) KARE Aquatic Macroinvertebrates Field Manual For Water Quality Monitoring, Mark K. Mitchell, M.S. and William B. Stapp, Ph.D (Fifth Edition), 1991 Water, Water Everywhere Water Quality Factors Reference Unit (Hach) Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams, Izaak Walton League
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness, phosphates, nitrogen, alkalinity) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) One fecal coliform test kit thermometer Seine net and pools dip net collection pans/buckets forceps

magnifying glass (for field study identication)
metric tape measure
meter stick
hip boots
safety glasses
stop watch
pH 7.0 Buffer solution
Others as supplied by Biovan from Juniata College
VCR/TV
microscopes (for identifying insects at school)
small Petri dishes
camera (optional for creating slides/prints of identified bugs)
film (print and/or slide)

Field Study: Muddy Run Watershed

Posters: Macroinvertebrates

Maps: Numerous (local and regional)

8: Water Quality Monitoring
Stone Creek and Juniata River

Goal:

The students will conduct water monitoring tests on the Juniata River and Standing Stone Creek to determine their water quality.

Objectives:

1. The students will collect water samples from the Juniata River and/or Standing Stone Creek for any or all of the following:
   a. nitrogen
   b. phosphate
   c. dissolved oxygen
   d. pH levels
   e. hardness
   f. alkalinity
   g. coliform bacteria
   h. biological oxygen demand.
2. Given a stream insects and crustaceans sheet, students will:
   a. identify the macroinvertebrate groups found in the water
   b. identify the water quality of the stream.
3. The students will observe and look for stream sediment and erosion problems.
4. The students will organize and keep records of collected data.
5. The students will explain the effect nitrates and phosphates have on aquatic life and vegetation of a stream.
6. The students will define "dissolved oxygen."
7. The students will explain the relationship between different levels of dissolved oxygen and diversity of aquatic life in a stream.
8. The students will decide if the dissolved oxygen levels in Standing Stone Creek and the Juniata River can support varieties of aquatic life.
9. The students will explain how coliform bacteria affects the oxygen level of water and aquatic life.
10. The students will participate in small groups.

Procedures:

Water samples are obtained during a field study of the Juniata River and/or Standing Stone Creek for evaluation. Personnel from the local waste treatment plant and/or high school students assist in the coliform bacteria, nitrate, and phosphate tests. Students conduct the tests for dissolved oxygen, pH, alkalinity, total hardness, macroinvertebrates, and the physical parameters of the streams, e.g., width, depth, velocity, turbidity, and water temperature. The students also document any environmental problems or concerns. Collected bug specimens are identified with microscopes at the school. The data are entered into a computer. The information gathered is used in various culminating activities related to identifying and resolving environmental degradation problems.

Assessment:

Performance Assessments, e.g., conduct water quality tests on stream, e.g., pH, dissolved oxygen, dissolved solids, turbidity; Teacher-Made Test; Alternative Assessment, i.e., fill water quality data sheet out for Juniata College and DER Bureau of State Parks

Resources to Implement:

Teacher handouts:	Most Common Measured Water Quality Parameters Water Quality Data Sheet Water Hardness Instruction Sheet (for Lamotte kit) Dissolved Oxygen Instruction Sheet (for Hach kit) Stream Order (used with permission of Juniata College) Macroinvertebrate Identication Sheets (used with permission of Juniata College)
Slides:	Standing Stone Creek- Location Shots (teacher created)
Videos:	SOS Water Quality Monitoring (Izaak Walton League)
Literature:	SOS Stream Insect & Crustaceans (macroinvertebrate ID sheet-Izaak Walton League) KARE Aquatic Macroinvertebrates Field Manual For Water Quality Monitoring, Mark K. Mitchell, M.S. and William B. Stapp, Ph.D (Fifth Edition), 1991 Water, Water Everywhere Water Quality Factors Reference Unit (Hach)

	Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams, Izaak Walton League
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness, phosphates, nitrogen, alkalinity) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) thermometer Seine net and pools dip net collection pans/buckets forceps magnifying glass (for field study identication) metric tape measure metric stick hip boots safety glasses stopwatch pH 7.0 Buffer solution Others as supplied by Biovan from Juniata College Slide Projector/Screen VCR/TV Microscopes small Petri dishes camera (optional for creating slides/prints of identified bugs) film (print and/or slide)
Field Study:	Standing Stone Creek Juniata River
Posters:	Macroinvertebrates
Maps:	Numerous (local and regional)

9: Limnological Testing
Juniata River

Goal:

The students will participate in water monitoring activities of the Juniata River to learn how to conduct tests and evaluate limnological information.

Objectives:

1. In order to simulate the work of limnologists, the students will collect data on the following:
   a. depth of water using line sounding device
   b. temperature
   c. turbidity (cloudiness of water)
   d. water speed
   e. water volume
   f. kinds of organisms which live in water by taking plankton samples using a plankton net.
2. The students will organize and keep records of collected data.
3. The students will use the appropriate instruments to measure collected water samples.
4. The students will explain what causes changes in river water (or ocean water) temperatures during the year as well at different places on the river.
5. The students will explain what affects the turbidity of a river or ocean.
6. The students will explain what line sounding is and explain how to do one.
7. The students will explain what a plankton net is and explain how to use it properly to obtain a sample of river (or ocean) plankton.
8. The students will explain how plankton helps life in a river or ocean.
9. Given a microscope, a slide, and plankton samples students will describe some types of plankton.
10. Given a worksheet, the average speed of the river, the average depth of the river and the average width of the river, the students will calculate the amount of water flowing down the Juniata River during a given day.

11. The students will interact in small groups.

Procedures:

Students learn how to conduct the pertinent limnological tests from their science teacher. Then, limnological field study tests are conducted at the Juniata River. The collected data are charted, graphed, and analyzed by the students in science and math classes at the Middle School. Educational activities involve cooperative learning as well as independent student work.

Assessment:

Performance Assessments of limnological tests, e.g., temperature, speed, volume, depth, plankton; Record Data, Teacher-Made Test; Alternative Assessment, i.e., students construct a topographic map of the Juniata River using data recorded at site

Resources to Implement:

Teacher handouts:	Juniata River Data Sheet Plotting river depth Water Quality Data Sheet Water Hardness Instruction Sheet (for Lamotte kit) Dissolved Oxygen Instruction Sheet (for Hach kit)
Videos:	SOS Water Quality Monitoring (Izaak Walton League)
Transparencies:	Plotting river depth
Literature:	Water, Water Everywhere Water Quality Factors Reference Unit (Hach) Field Manual For Water Quality Monitoring
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) thermometer Plankton net/ropes Collection pans/buckets forceps metric tape measure meter stick hip boots safety glasses stop watch pH 7.0 Buffer solution

gloves
microscopes
small Perti dishes
Line sounding device
Secchi disc
six/twelve small apples
VCR/TV
Overhead Projector/Screen
camera (optional for creating slides/prints of student findings)
film (print and/or slide)

Posters: Macroinvertebrates

Field Study: Juniata River/Port Bridge

#10: Water Treatment Plant

Goal:

The students will understand how the Huntingdon Water Treatment Plant operates.

Objectives:

1. The students will list chemicals used to treat drinking water:
   a. alum
   b. fluoride
   c. chlorine
   d. carbon.
2. The students will recall the steps for water treatment.
3. The students will explain how the Huntingdon Water Filtration Plant treats our drinking water.
4. The students will name the community source of the drinking water.
5. The students will explain why alum, fluoride, chlorine, and carbon are used at the local water treatment plant.
6. The students will compare their sources of drinking water to other peoples water sources.
7. The students will examine the cost of having clean drinking water available to people in this community.
8. The students will explain why water for personal consumption must be treated.
9. The students will recall the amount of water available for human use compare to all the water that is located on earth.

Procedures:

Teachers review how a water treatment plant operates in regular Middle School classes. Then, students participate in a fieldtrip to the Huntingdon Water Treatment Plant. Personnel from the plant conduct small group tours and explain the operations of the facility. The students witness various processes that domestic water goes through at the water plant. If time permits, students compare different water treatment plants.

Assessment:

Teacher-Made Test; Alternative Assessment, i.e., students construct model water plant when given all parts to its operation

Resources to Implement:

Teacher handouts:	Description of Huntingdon Plant Flow Diagram of Huntingdon Water Treatment Plant (used with permission of the Huntingdon Water treatment plant)
Slides:	Huntingdon Water Treatment Plant (teacher created)
Transparencies:	Making Water Pure (Water Quality and Pollution, Milken Publishing Company) Flow Diagram of Huntingdon Water Treatment Plant (used with permission of the Huntingdon Water treatment plant)
Equipment:	Slide Projector/Screen Overhead Projector/Screen
Field Study:	Huntingdon Water Treatment Plant

#11: Waste Water Treatment Plant

Goal:

The students will understand how the Huntingdon Waste Water Treatment Plant operates.

Objectives:

1. The students will list chemicals used to treat sewage waste.
2. The students will recall the steps for the treatment of waste materials at the local facility.
3. The students will explain how the Huntingdon Waste Water Plant cleans waste before water is released into the Juniata River.
4. The students will name and locate the community sewage treatment plant.
5. The students will explain why chlorine is used at the local waste water treatment plant.
6. The students will examine the usages of clean sludge.
7. The students will relate sewage waste to other forms of nutrient enrichment and their effect on dissolved oxygen levels in water.

Procedures:

The science teacher instructs students as to how a waste water treatment plant operates. Then, students participate in a fieldtrip to the Huntingdon Waste Water Treatment Plant. Personnel from the plant conduct small group tours and explain the operations of the facility. Students witness various water tests conducted at the plant. Upon the return to school, the students examine the possible uses for sludge. If time permits, students compare different types of waste water treatment facilities.

Assessment:

Teacher-Made Test; Alternative Assessment, i.e., identify sections of local waste water plant

Resources to Implement:

Teacher handouts:	Description of Huntingdon Plant Flow Schematic Diagram of Huntingdon Waste Water Treatment Plant (used with permission of the Huntingdon Waste Water Treatment Plant)
Slides:	Huntingdon Waste Water Treatment Plant (teacher created)
Videos:	The Treatment of Wastewater (PA DER) The Ripple Effect (CBF) Into the Water, Into the Bay (CBF)
Transparencies:	Flow Diagram of Huntingdon Waste Water Treatment Plant (used with permission of the Huntingdon Waste Water Treatment Plant) Waste Water Treatment (Water Quality and Pollution, Milken Publishing Company)
Literature:	Biodegradable waste and the water environment (KARE Water Resources in PA)
Equipment:	Slide Projector/Screen VCR/TV Overhead Projector/Screen
Field Study:	Huntingdon Waste Water Treatment Plant
Posters:	Numerous

#12: Studying a Stream from Headwater to Mouth

Goal:

The students will identify and describe the sources of fresh water in and on the earth (specifically Standing Stone Creek).

Objectives:

1. The students will identify the pathway of water on a map.
2. The students will interpret the direction in which water in a river/stream is moving on a map.
3. The students will identify parts of a river.
4. The students will describe the path a river/stream takes from its headwater to its mouth.
5. The students will describe how rivers change land, e.g., erosion, deposition and meandering.

Procedures:

Students participate in a field study of Standing Stone Creek from its source to its mouth, making four stops along the way for studies and examinations. The science instructor shares further facts about fresh water in the students regular classes at the Middle School.

Assessment:

Teacher-Made Test, Alternative Assessment, e.g., students 1) trace local watershed from topographic maps, 2) determine stream length, 3) identify tributaries to stream

Resources to Implement:

Teacher handouts:	Data Collection Sheet for science Water Quality Data Sheet
Slides:	Standing Stone Creek- Location Shots (teacher created)
Transparencies:	Muddy Run Watershed (Huntingdon Conservation Agency) Typical Watershed (KARE Water Resources in PA)

Literature:	Scot Foresman Science text, (Water On Earth unit, pp. 287-303)
Equipment:	Collection bottles (bring water back to school for testing water) Overhead Projector/Screen
Field Study:	Standing Stone Creek
Posters:	Numerous
Maps:	Numerous (local and regional)

#13: Groundwater

Goal:

The students will gain an appreciation of groundwater, why it is important and the positive and negative impact man has had on it.

Objectives:

1. The students will describe a water table.
2. The students will explain how a water table is related to water level in rivers, lakes, wells, and lands.
3. The students will describe where their drinking water comes from.
4. The students will describe where their waste water goes once it leaves their home.
5. The students will state three things they can do at their home to help protect groundwater.
6. The students will explain the term "groundwater contamination".
7. The students will examine the hydrocycle to discovery how the polluted soil affects water.
8. The students will read about sources of pollution affecting the soil and thus groundwater.
9. The students will explain how the soil, air, and water interconnect to cause different types of pollution.
10. The students will ascertain and list common sources of groundwater pollution.
11. The students will participate in groups to explain how to reduce groundwater pollution.

Procedures:

Science and social studies instructors teach the topic of groundwater in the students' regular classes. Personnel from the Conservation Agency (or teachers) make a presentation using a groundwater model to demonstrate how water travels through soil. In social studies class, students learn the relationship of groundwater to pollution. Students also create their own groundwater models using a quart jar, gravel, and other materials.

Assessment:

Alternative Assessments, e.g., students 1) engage in a cooperative learning activity to list types and sources of groundwater pollution in the local watershed, 2) construct a groundwater model using a quart glass jar, gravel, and other materials; Teacher-Made Test

Resources to Implement:

Teacher handouts:	Cooperative Groundwater Activity
Videos:	Common Ground (PA Fish and Boat Commission) Into the Water, Into the Bay (CBF) The Ripple Effect (CBF)
Transparencies:	Groundwater Pollution (KARE Water Resources in PA)
Literature:	"Protecting Groundwater is Everyone's Business" (Bay fact sheet #8) Groundwater A Primer For Pennsylvanians (League of Women Voters of Pennsylvania Citizens Education Fund) Sandcastle Moats And Petunia Bed Holes A book about ground water, 1994, pp. 3-13. (DER Commonwealth of PA) Groundwater Contamination (League of Women Voters of Pennsylvania Citizens Education Fund)
Equipment:	Groundwater Model (University of Wisconsin) Glass quart jar/rocks/gravel VCR/TV Overhead Projector/Screen
Field Study:	Joller Mines (abandon coal mining town) Fouses's Crossing, Raystown Lake
Posters:	Numerous

#14: Wetlands

Goal:

The students will appreciate the functions that wetlands and other forms of vegetation have in benefiting and preventing the degradation of the environment.

Objectives:

1. The students will define the term "wetland".
2. The students will recall the term "flood plain".
3. The students will explain how a water table is related to water levels in the earth.
4. The students will compare residential and natural wetland areas of a drainage basin.
5. The students will recognize the benefits of wetlands and vegetation and why they are important in regard to:
   - natural filtering system
   - recharges the soil with water
   - prevents flooding
   - natural buffers
   - wildlife habitat.
6. The students will explain the interrelationship of precipitation, runoff and wetlands.
7. The students will define the term "groundwater recharge".
8. The students will describe the consequences further destruction of wetlands will have on the environment.
9. Given a topographical map students will predict/select areas in a region where wetlands can exist.
10. The students will explain the relationship of porous and impervious surfaces to groundwater levels, runoff and wetlands.
11. The students will explain how specific human land management practices can affect a wetlands.
12. The students will describe how plants remove pollutants from the water.
13. The students will explain how wetland soils can filter pollutants out of water.

Procedures:

Students read information about wetlands from the resources WOW!: The Wonders of The Wetlands and Juniata College's Wetland Module and see one of two videos: "Wetlands, Maligned Treasures" or "Wealth of Wetlands". We also use our drainage basin model for visualization of the benefits of wetlands. The students compare the residential developments in the wetland area of the Muddy Run Watershed to natural wetland areas that do not have developments. Then, the students participate in a fieldtrip to residential areas of the Muddy Run Watershed and to the created wetlands at Raystown Lake where they conduct water monitoring tests related to a wetland.

Assessment:

Teacher-Made Test; Performance Assessment, i.e., conducting appropriate water monitoring test for pH, dissolved oxygen, etc.

Resources to Implement:

Teacher handouts:	Basic Facts About Wetlands (adapted from WOW! The Wonders of Wetland) Why Wetlands are Important Wetlands (adaptations of Juniata College Outreach Program, Wetland Module, used with permission) Cooperative Wetlands Activity
Videos:	Wetlands, Maligned Treasure (DER) Wealth of Wetlands (PA Fish and Boat Commission) Wetland in Crisis (PA Fish and Boat Commission)
Literature:	WOW! :The Wonders of Wetland, 1993 pp. 7-11 Mid-Atlantic Wetlands A Disappearing Natural Treasure, 1987 America's Wetlands Our Vital Link Between Land and Water, 1988 Juniata College's Wetland Module, 1995
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness, phosphates, nitrogen, alkalinity) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) hip boots pH 7.0 Buffer solution VCR/TV
Field Study:	Huntingdon Area Middle School property Muddy Run Watershed Fouse's Crossing, Raystown Lake

#15: Acidity/Acid Precipitation

Goal:

The students will examine the effects acidity/acid rain has on the environment in general and in more detail on water quality and aquatic life.

Objectives:

1. The students will define and recall the term "acid rain" as well as other related acid rain terminology.
2. The student will explain the impact burning fossil fuels has on the creating acid precipitation.
3. The students will explain the difference between acid and base using pH parameters.
4. The students will explain the consequences high levels of acidity have on aquatic life.
5. The students will list examples of acidic and alkaline substances.
6. The students will describe the consequences that increased usage of fossil fuels has on the environment.
7. The students will appreciate the cost involved in attempting to resolve environmental problems created by burning excessive amounts of coal.
8. The students will learn/recall what can be done to reduce acid rain.
9. The students will conduct pH tests of local waterways.
10. The students will apply computer technology to enter, store, and retrieve collected pH data.

Procedures:

The students study the topic of acidity/acid rain in the classroom and then visit a coal mine to witness first hand the impact that coal mining has on the environment. Numerous water monitoring tests, e.g., pH, dissolved oxygen, total hardness, occur to compare the water in this area to streams of good water quality. The information is entered into a computer for different independent studies or projects of interest to the students.

Assessment:

Teacher-Made Test; Performance Assessments, e.g., students 1) conduct water monitoring tests like pH, dissolved oxygen, dissolved solids; Alternative Assessment, i.e., voluntary individual/small group environmental projects

Resources to Implement:

Teacher handouts:	Basic Facts About Acid Rain (from Acid Rain: A Student First Sourcebook)
Videos:	Acid Rain: Requiem or Recovery (Pa Fish and Boat Commission)
Transparencies:	pH range that supports aquatic life (Water Wise Lessons in Water Resources) How Acid Rain Forms (KARE Water Resources in PA)
Literature:	Acid Rain: A Student First Sourcebook, 1990 (EPA) How Acid Rain Forms (KARE Water Resources in PA) pH of Common Substances (Water Wise Lessons in Water Resources, 1989) pH range that supports aquatic life (Water Wise Lessons in Water Resources)
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness, alkalinity) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) hip boots pH 7.0 Buffer solution VCR/TV Overhead Projector/Screen
Field Study:	Joller Mines (abandon coal mining town)
Posters:	Numerous

#16: County Water Quality Monitoring Program

Goal:

The students will participate in a county-wide water quality monitoring program.

The Bureau of State Parks objectives are:

1. To promote the interaction of area students, teachers and concerned citizens in a common effort to increase environmental education and stewardship (Bureau of State Parks)
2. To train participants (students) in physical, chemical and biological water monitoring techniques (Bureau of State Parks)
3. To encourage communication and exchange of ideas among the educational institutions in the county area (Bureau of State Parks)
4. To establish a water quality monitoring network within the county (Bureau of State Parks)
5. To provide a data bank of water quality information where little or no information exists for use by those affiliated with the program (Bureau of State Parks).

Student Objectives:

1. The students of the Huntingdon Area Middle School will engage in individual and group projects using computer technology.
2. The students will participate in standardized and coordinated water quality testing projects.
3. The students will use data to establish a baseline of water quality and to evaluate and monitor future trends on a long term basis.
4. The students will increase public awareness of water quality issues.
5. The students will take action to improve and protect water quality.
6. The students will students collect and store data into a computer.

Procedures:

Sixth-grade students from the Huntingdon Area Middle School participate in a water quality monitoring program sponsored by the Huntingdon County Planning Commission in conjunction with Juniata College. The water quality data is shared with all concerned agencies. Students who have access to computers use the acquired information to plot and analyze the information.

Assessment:

Performance Assessment, i.e., students conduct water tests for pH, nitrogen, phosphate, dissolve solids, dissolved oxygen, alkalinity, water harness, macroinvertebrates, stream speed, stream volume, stream depth, and water temperature, turbidity; Alternative Assessments, e.g., students 1) record data, 2) complete DER report form, 3) do a stream analysis

Resources to Implement:

Teacher handouts:	Most Common Measured Water Quality Parameters Water Quality Data Sheet Water Hardness Instruction Sheet (for Lamotte kit) Dissolved Oxygen Instruction Sheet (for Hach kit) Stream Order (used with permission of Juniata College) Macroinvertebrate Identication Sheets (used with permission of Juniata College)
Videos:	SOS Water Quality Monitoring (Izaak Walton League)
Literature:	Student Handbook Water Quality Monitoring Program (PA Bureau State Parks) Field Manual For Water Quality Monitoring, Mark K. Mitchell, M.S. and William B. Stapp, Ph.D (Fifth Edition), 1991 SOS Stream Insect & Crustaceans, macroinvertebrate ID sheet-Izaak Walton League) Water, Water Everywhere Water Quality Factors Reference Unit (Hach) KARE Aquatic Macroinvertebrates Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams, Izaak Walton League
Equipment:	Water Monitoring Kits (e.g., dissolved oxygen, water hardness, pH, phosphates, nitrogen, alkalinity) Water Monitoring Meters (e.g., dissolved oxygen, pH, dissolved solids) thermometer

	Seine net and pools dip net collection pans/buckets forceps magnifying glass (for field study identication) metric tape measure meter stick hip boots orange or ball safety glasses stopwatch pH 7.0 Buffer solution Others as supplied by BIOVAN from Juniata College VCR/TV Microscopes small Perti dishes
Field Study:	Standing Stone Creek Muddy Run
Posters:	Macroinvertebrates
Maps:	Numerous (Muddy Run Watershed and regional watersheds)

#17: Computer Technology

Goal:

The students will use a computer to write a brief report, keep records, construct charts and graphs, and exchange data with other sources.

Objectives:

1. The students will exhibit an understanding of the integration of the language arts and science by writing a report on their selected topic concerning the environment.
2. The students will use encyclopedias and nonfiction books, booklets, or brochures to locate information about a specific topic.
3. The students will take notes from research material by paraphrasing and selecting essential information.
4. The students will organize information to write a small report about an environmental topic.
5. The students will use computer word processing skills to publish a final product.
6. The students will write in paragraph form and use the rules of capitalization and punctuation.
7. The students will record data using a computer.
8. The students will use Cricket Graph to construct graphs dealing with rainfall data.
9. The students will participate in an interdisciplinary, cross-grade project involving other schools.
10. The students will transmit scientific data as defined in the protocols of the GLOBE Program.

Procedures:

After participating in the Environmental Education and Water Study Program, students complete this task by using their team teaming class period. If time to complete this assignment becomes a problem, the team uses an existing language arts and science project to obtain the goal of computer usage. The format for completing the

paper can be altered to incorporate the use of a computer. The advantage to this is that students participate in a complete writing program over several days. This also gives our learning disability students the opportunity to use the computer in the resource lab. Students also create their own rainfall charts using Cricket Graph. Thereafter, they have the option of doing voluntary survey analyses that include computer charts. Beginning the 1995/96 school year students will use computers in a few interdisciplinary, cross-grade, cross-school district projects via the internet and will also participate in the GLOBE Program where they will be recording and sending scientific data by computer and internet.

Assessment:

Alternative Assessments, e.g., students 1) complete narrative writing assignment using computer word processing program, 2) create charts using Cricket graph, 3) create and analyze environmental survey using computer technology

Resources to Implement:

Teacher handouts:	Huntingdon Borough Rain Data Huntingdon County Rain Data
Transparencies:	Graphing Your Data (teacher created)
Equipment:	Mac LC 575 Performa in class or computer lab computers Style Writer Pro Printer (colored printer) Cricket Graph program Other computer software as desired (e.g., Word 5.0, Works Spreadsheet) Overhead Projector/ Screen

Standards and Outcomes Addressed by the Program

National Standards of Teachers of Mathematics (NCTM)

. Pose tasks based on sound and significant mathematics.
. Build on students' prior experience and knowledge.
. Develop mathematics thinking skills that convince students of the validity of particular representations, solutions, conjectures, and answers.
. Engage students' intellect: pose questions and tasks that elicit, engage, and challenge each students' thinking.
. Develop students' mathematical knowledge and skills.
. Stimulate students to make connections and develop a coherent framework for mathematical ideas.
. Call for problem formulation, problem solving, and mathematical reasoning.
. Promote the development of all students' dispositions to do mathematics.
. Develop an instructional model based on the range of ways students learn mathematics.

National Center for Improving Science Education (SCISE)

. Accessible to all students
. Build on students' prior experience and knowledge.
. Use an instructional model based on scientific process such as: question, discover, create, communicate, and pursue new questions.
. Relate to personal and social needs.
. Select science concepts that are developmentally appropriate, with illustrative examples drawn from the content on multiple disciplines of science.
. Develop scientific thinking skills such as drawing conclusions based on evidence, using inference, creating models.
. Developing scientific habits of mind such as curiosity, skepticism, honesty, living with ambiguity.
. Shift the role of teacher from imparter of knowledge to designer and facilitator of learning.
. Seek relevant and significant applications of science content and concepts to students' personal and community life.

Pennsylvania Learning Outcomes Addressed By Our Interdisciplinary Program

MATHEMATICS

. All students use numbers, number systems and equivalent forms including numbers, words, objects and graphics to represent theoretical and practical situations
. All students compute, measure and estimate to solve theoretical and practical problems, using appropriate tools, including modern technology such as calculators and computers.
. All students apply the concepts of patterns, functions and relations to solve theoretical and practical problems.
. All students formulate and solve problems and communicate the mathematical processes used and the reasons for using them.
. All students understand and apply basic concept of algebra, geometry, probability and statistics to solve theoretical problems.
. All students evaluate, infer and draw appropriate conclusions from charts, tables and graphs, showing the relationships between data and real-world situations.

. All students make decisions and predictions based upon the collection, organization, analysis and interpretation of statistical data and the application of probability.

SCIENCE AND TECHNOLOGY

. All students use and master materials, tools, and processes of major technologies which are applied in economic and civic life.
. All students explain the relationships among science, technology and society.
. All students construct and evaluate scientific and technological systems using models to explain or predict results.
. All students develop and supply skills of observation, data collection, analysis, pattern recognition, prediction and scientific reasoning in designing and conducting experiments and solving technological problems.
. All students evaluate advantages, disadvantages and ethical implications associated with the impact of science and technology on current and future life.
. All students evaluate the impact on current and future life of the development and use of varied energy forms, natural and synthetic materials, and production and processing of food and other agricultural products.

ENVIRONMENT AND ECOLOGY

. All students understand and describe the components of ecological systems and their functions.
. All students analyze the effects of social systems, behaviors and technologies on ecological systems and environmental issues.
. All Students think critically and generate potential solutions to environmental issues.
. All students evaluate the implications of finite natural resources and the need for conservation, sustainable agricultural development and stewardship of the environment.

CITIZENSHIP

. All students examine and evaluate problems facing citizens in their communities, state, nation and world by incorporating concepts and methods on inquiry of various social sciences
. All students develop and defend a position on current issues, confronting the United States and other nations, conducting research, analyzing alternatives, organizing evidence and arguments, and making oral presentation.
. All students demonstrate their skills of communicating, negotiating and cooperating with others.
. All students demonstrate that they can work effectively with others.

COMMUNICATIONS

. All students write for a variety of purposes, including to narrate, inform and persuade, in all subject areas.
. All students respond orally and in writing to information and ideas gained by reading narrative and informational texts and use the information and ideas to make decisions and solve problems.Huntingdon Area Middle School

Student Community Actions

Following are students actions that result from their participating in the program:

#1: Students conducted water quality monitoring tests of a local waterway and thus helped to resolve a local raw sewage problem.

#2: Students educated the public about land management practices which would prevent stormwater runoff.

#3: Students created and disseminated a booklet about the effects of household pollutants.

#4: Students started a school recycling program.

#5: Students gave donations to various organizations to stop the degradation of the rainforests.

#6: Students provided data for a county-wide water quality monitoring program.

#7: Students made public presentations about their environmental work and their findings.

#8: Students published letters to the editor in the daily newspaper and wrote to political leaders about their concerns for the environment.

#9: Students planted trees to prevent stormwater runoff.

#10: Students wrote letters and petitioned the conservation district to create a wetland and stormwater retention pond on school property.

#11: Students wrote letters and petitioned state and local authorities to resolve the infiltration and overloading of a community sewage line with groundwater.

#12: Students started a Community Tree Planting Project in conjunction with the borough to restore trees and beautify the community.

Audiovisual Materials

Slides:

1. Location and Physical Characteristics of Muddy Run
2. Stormwater Runoff
3. Positive Stormwater Management Practices found in the Residential Areas of the Watershed
4. Negative Environmental Findings in Watershed
5. Documented Student Learning Activities Experienced during Environmental Studies
6. Huntingdon Water Treatment Plant
7. Huntingdon Waste Treatment Plant
8. Stone Creek Nutrient Enrichment/Water Monitoring
9. Household Pollutant Alternatives

VHS Tapes:

1. Save Our Streams (Issac Walton League) - A Guide to Water Quality Monitoring
2. Chesapeake Bay Foundation
   a. Living on the Edge
   b. Pointless Pollution
   c. Into the Water, Into the Bay
   d. Common Ground
   e. The Ripple Effect
   f. Hey! Hey! It's Happening Today On The Chesapeake Bay
3. Department of Environmental Protection
   a. Wetlands: Maligned Treasures (Bureau of Dams, Waterways and Wetlands)
   b. The Treatment of Wastewater (Bureau of Water Control Management)
4. Pennsylvania Fish and Boat Commission, Bureau of Education/ Information
   a. Wetlands in Crisis
   b. America's Wetlands
   c. The Wealth in Wetlands
   d. Conserving America The Wetlands
   e. Acid Rain A North American Challenge
   f. Acid Rain Requiem or Recovery
   g. The Water Cycle and Erosion
   h. Water: A Precious Resource

VALUABLE CONTACTS

1. Local Resources and People
   a. Conservation Agency (maps, information, presentations)
   b. Water Filtration Plant (personnel)
   c. Waste Water Treatment Plant personnel (field study, water testing assistance)
   d. Teachers
   e. Property owners

2. Organizations associated with the Chesapeake Bay
   a. PA Chesapeake Bay Education Office, 225 Pine Street, Harrisburg, PA, 717-236-1006 (mini-grants, educational materials)
   b. Chesapeake Bay Foundation, 162 Prince George Street, Annapolis, MD 21401 (summer teacher training, educational materials: projects, fact sheets, homeowner series, etc.)
   c. Chesapeake Bay Foundation, 214 State Street, Harrisburg, PA 17101- 717-236-8825 (Summer Teacher Training Courses)
   d. Chesapeake Bay Liaison Office, Environmental Protection Agency, 410 Servern Avenue, Annapolis, MD 21401 (vast numbers of environmental reports, booklets, etc.)
   e. Chesapeake Bay Regional Information Service -800-662-CRIS (materials, booklets, reports, etc.)
   F. Alliance for Chesapeake Bay, 6600 York Road, Suite 100, Baltimore, MD 21212 (river fact sheets, booklets, Earth Day Activities, etc.)

3. Izaak Walton League of America, Save Our Streams, 1401 Wilson Boulevard, Level B, Arlington VA 22209 (tremendous water quality monitoring resources)

4. Juniata College, Juniata College Outreach Program (Science in Motion) and Raystown Field Station, Huntingdon, PA 16652- 814-643-4310 (Summer Teacher Training Workshops, Bio and Chem Vans to your school)

5. Intermediate Unit for your area, i.e., Tuscarora Intermediate Unit 11, RR 1 Box 70A, McVeytown, PA 17051-814-542-2501 (teacher in-service for Project Learning Tree, Aquatic Wild, KARE, etc.)

6. Department of Environmental Resources (DER), Office of Public Liaison, P.O. Box 2063, Harrisburg, PA 17120 - 717-783-7005, The are several departments, e.g., Bureau of State Parks, ask for contact for information you are requesting, e.g., water pollution, acid rain, stormwater, etc. (can receive a lot of factual content, Earth Week booklet, grant possibilities)

7. PA Dept. of Education, Office of Environmental Education, 333 Market Street, Harrisburg, PA 17126-0003 (Environmental education materials)

8. A/V Librarian, Bureau of Education and Information, Pennsylvania Fish and Boat Commission, P.O. 1673, Harrisburg, PA 17105 -1673 (environmental video tapes)

9. Hach Company, P.O. Box 389, Loveland CO 80539 - 800-227-4224 (water test kits)

10. LaMotte Co., PO Box 329, Chestertown, MD 21620 - 800-244-3100 (water test kits)

Appendices

Sample of Water Quality Data Sheets

- Most Common Water Parameters
- Water Quality Data Sheet (Muddy Run)
- Stone Creek Data Sheet
- Limnological Data Sheet (Juniata River)

Most Commonly Measured Water Quality Parameters

Parameter	Unpolluted Stream	Polluted Stream
Dissolved Oxygen	The higher the amount of oxygen the better the quality...Trout- 10 ppm, Bass- about 7/8 ppm 0-3 Creatures flee 4-5 Creatures can survive Greater than 5 Creatures thrive	Less than 5 ppm is considered unacceptable for most aquatic organisms
Biological Oxygen Demand (B.O.D.)	The lower the B.O.D. the less organic matter in a stream Less than 2 ppm is good Greater than 5 ppm means poor water quality	High B.O.D. indicates large amounts of organic matter
Nitrates and/or Phosphates	Nitrates are necessary for organisms in small quantities Clean water- less than 0.1 ppm	Higher reading indicates fertilizer, industrial waste, sewage and/or other nutrient enrichments Causes algae blooms Greater than 10 ppm is nutrient loading the water
pH (Hydrogen ion present)	Water with PH range from 6.5-8.6 will have little effect on life processes	Water with pH less than 5 or greater than 9 will support little aquatic life
Suspended Solids	S.S. causes turbidity of water... Clean water has low turbidity...Clear water is in the 1-15 ppm range	Caused by erosion, plankton growth, or waste water...Above 50 ppm is turbid
Total Hardness	Soft water- 0-60 ppm Hard water 120-180 ppm	Values below 250 ppm are acceptable for drinking Over 500 ppm is hazardous to health

Aquatic Organisms (Macroinvertebrates)	Clean water has higher diversity of organisms - high numbers of different species More Taxa I & II	Polluted water - number of organisms may be high but little variety Mostly Taxa III
Coliform (Fecal)	Less than 200/100 ml is considered acceptable, the lower the better Anything > 200/100 ml is unhealthy for human consumption	Streams vary in count, but anything greater than 5,000/100 ml is hazardous
Dissolved Solids	Clean water has low amounts of D.S., ... Clear water is water less than 50 ppm... 50 ppm to 150 ppm is not bad average is unacceptable...single test should not be over 750 ppm	Caused by erosion, runoff, materials from industries, etc. Over 500 ppm for any monthly
Alkalinity	Good streams have between 100 and 200 ppm... are able to buffer the water from acidity	Poor streams have lower alkalinity levels, < 50 ppm... could be effected by acid rain or acid mine drainage

NOTE: A part per million (ppm) is the same as a milligram per liter (mg/l) It is equal to covering an entire football field with golf balls and having one orange or different type. Therefore, small amounts of many toxic chemicals or substances can be very harmful or detrimental to the environment.

WATER QUALITY MONITORING DATA SHEET

NAME: _____

WATERSHED: _____

PLACE: _____

DATE: _____ TIME: _____ GROUP: _____

WATER TESTS AND METHODS

****

DIS OXYGEN	PH	HARDNESS	DIS SOLIDS	NITRATE	PHOSPAHTE	ALKALINITY	MACROINVERTEBRATES
Chemical		Chemical	Chemical	Chemical	Chemical	Chemical	Seine Net
Electric	Elec	Electric	Electric	Electric	Electric	Electric	Scooper

Stone Creek Data Sheet Name _____

Section _____

During this field trip we will be stopping at four places along Stone Creek to collect data. We will be stopping at (1) a small streamlet that forms the headwaters of the creek, (2) two places along the creek and (3) a place near the mouth of Stone Creek.

Focus Question - How does the speed of the water in a stream (or river) change as the water moves from the head to the mouth?

At each location we will measure and mark off a fifteen foot section of the creek. A student will then throw a ping pong ball into the creek above the marked off section. We will use a stop watch to measure the time it takes for the ping pong ball to float past the ten foot section of creek starting at the up stream marker and stopping at the down stream marker. Each student must then record the time in the spaces provided below. If we take the distance the water has traveled (15 feet) and divide that by the time it took (the number of seconds) we will have the speed of the water (in feet per second).

Location 1 - Distance 15 ft / Time _____ = _____ feet/second

Location 2 - Distance 15 ft / Time _____ = _____ feet/second

Location 3 - Distance 15 ft / Time _____ = _____ feet/second

Location 4 - Distance 15 ft / Time _____ = _____ feet/second

Conclusion: How does the speed of the water in a stream (or river) change as the water moves from the head to the mouth?

Focus Question - How does the width of a stream (or river) change from the head to the mouth?

At each location students will measure the width of Stone Creek within the fifteen foot section marked off. To do this one student will throw a rope (with a weight attached to it) across the water to the other side. The rope will then be pulled until the weighted end is on the edge of the far side of the creek. The rope will be marked on the other side of the stream where the bank ends and the water begins. The rope will then be pulled back across the creek and the distance measured. Below record the width of the creek at each location.

Location 1 - _____ feet

Location 2 - _____ feet

Location 3 - _____ feet

Location 4 - _____ feet

Conclusion - How does the width of a stream (or river) change from the head to the mouth?

#Group #_____ #Data Sheet - Juniata River#

1. #Members of the Group#

A. _____ B. _____

C. _____ D. _____

E. _____ F. _____

---

2. #Speed of the River#

1st Time _____ sec. 2nd Time _____ sec. 3rd Time _____ sec.

** Groups Average Time _____ sec. to travel 100 ft. **

** Speed = _____ ft./sec. **

---

3. #Temperature of the Water# - (in Fahrenheit and Celsius degrees)

A. _____ F' _____ C' B. _____ F' _____ C' C. _____ F' _____ C'

D. _____ F' _____ C' E. _____ F' _____ C' F. _____ F' _____ C'

** Groups Temperature Average = _____ F' _____ C' **

---

4. #Cloudiness of the Water# - Check off what the majority of the group feels is correct. Tell #why# the water may be in the condition that it is.

Crystal Clear - _____ Explanation :
Slightly Cloudy - _____
Very Cloudy - _____

---

5. #Depth of Water - Line Sounding# (Marks are six (6) inches apart.)

A. _____ marks = _____ inches B. _____ marks = _____ inches

C. _____ marks = _____ inches D. _____ marks = _____ inches

E. _____ marks = _____ inches F. _____ marks = _____ inches

** Average Depth of the Water is _____ inches.**

---

5. **#Plankton Samples#** - Check off how your sample looks.

A. #Living# #Non-living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

B. #Living# #Non-living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

C. #Living# #Non-Living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

D. #Living# #Non-living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

E. #Living# #Non-living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

F. #Living# #Non-Living#

none ____	none ____
some ____	some ____
large	large
amount ____	amount ____

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